

Ralph Edward Milliken, Ph. D.

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EDUCATION

Ph. D. Brown University Department of Geological Sciences 2006

Quantifying and modeling the water content of geological materials using VIS-NIR reflectance spectroscopy: Applications for laboratory and spacecraft data

M. S. Brown University Department of Geological Sciences 2003

Viscous flow features on the surface of Mars: Observations from high-resolution Mars Orbiter Camera (MOC) images

B. S. Indiana University Department of Geological Sciences 2001

geology major, minors awarded in physics and mathematics

Microbial sulfate-reduction in waters retrieved from ultra-deep South African gold mines

Geology Field Camp Indiana University Geologic Field Station 1999

A 6-week field course that integrates stratigraphic analyses, structural problems, regional tectonics, and environmental geology within a problem-solving framework.

RESEARCH EXPERIENCE

2007 – present *Research Scientist* Jet Propulsion Laboratory/Caltech
Geophysics & Planetary Geosciences ‘Strategic Hire’

2006 – 2007 *Post-Doctoral Scholar* Caltech/Jet Propulsion Laboratory
supervisor: Dr. John Grotzinger (Caltech)

2001 – 2006 *Graduate Student Research Assistant* Brown University
advisor: Dr. John Mustard

1999 – 2001 *Undergraduate Research/Lab Assistant* Indiana University
advisor: Dr. Lisa Pratt

1999 – 2000 *Undergraduate Research* Indiana University
advisor: Dr. Abhijit Basu

1998 – 2000 *Editorial Assistant* Indiana University
Assisted Dr. Abhijit Basu, Chief Science Editor for the Geological Society of America’s Special Papers and Memoirs

AWARDS

- 2006 Juokowsky Foundation Outstanding Dissertation Award nominee *Brown Univ.*
2003 Best Student Presentation, runner-up *Clay Minerals Society 40th Annual Mtg.*
2003 Clay Minerals Society travel grant *Clay Minerals Society*
2001 Best Oral Presentation *Student Research Day at Indiana University*
2001 Faculty Scholarship Award *Dept. Geological Sciences at Indiana University*
1999 Junior Student Award *Dept. Geological Sciences at Indiana University*

PUBLICATIONS

In Preparation (first author)

- Milliken, R. E.** and D. Bish (2009), Zeolite phase transitions during dehydration: An FTIR and XRD study.
Milliken, R. E., N. Mangold, J. Grotzinger, and N. Tosca (2009), Clay and evaporite sequences in closed basins on Mars.
Milliken, R. E., J. Grotzinger, J. Grant, and S. Murchie (2009), Sedimentary sources and sinks on Mars: Ladon, Eberswalde, and Holden Crater.

Submitted / In Review

- Milliken, R. E.**, W. Fisher, and J. Hurowitz (2008), Missing salts on early Mars, *Science*, *submitted*.
Milliken, R. E. and A. Rivkin (2008), Evidence for a brucite-carbonate alteration assemblage on Ceres, *Nature*, *submitted*.
Weitz, C. M., **R. E. Milliken**, J. Grant, A. McEwen, R. Williams, J. Bishop, and B. Thomson (2008), Mars Reconnaissance Orbiter observations of light-toned layered deposits and associated fluvial landforms on the plains adjacent to Valles Marineris, *Icarus*, *in review*.
Hurowitz, J. A., M. Wyatt, G. Taylor, S. McLennan, and **R. E. Milliken** (2008), A global perspective on Martian chemical weathering, *Geology*, *in review*.
Hubbard, B., J. Kargel, and **R. E. Milliken** (2008), Recent polythermal glaciation on Mars, *Nature Geoscience*, *in review*.

Selected Journal Publications

- Milliken, R. E.**, G. Swayze, R. Arvidson, J. Bishop, R. Clark, B. Ehlmann, R. Green, J. Grotzinger, R. Morris, S. Murchie, J. Mustard, and C. Weitz (2008), Opaline silica in young deposits on Mars, *Geology*, *36(11)*, 847-850.
Weitz, C. M., **R. E. Milliken**, J. Grant, A. McEwen, R. Williams, and J. Bishop (2008), Light-toned strata and inverted channels adjacent to Juventae and Ganges Chasmata, Mars, *Geophysical Research Letters*, *35*, doi:10.1029/2008GL035317.
Bishop, J. L., E. Noe Dobrea, N. McKeown, M. Parente, B. Ehlmann, J. R. Michalski, **R. E. Milliken**, F. Poulet, G. Swayze, J. Mustard, S. L. Murchie, and J.-P. Bibring (2008), Phyllosilicate diversity and past aqueous activity revealed at Mawrth Vallis, Mars, *Science*, *321*, 830-833.

- Mustard, J. F., S. L. Murchie, S. M. Pelkey, B. L. Ehlmann, **R. E. Milliken**, J. A. Grant, J.-P. Bibring, F. Poulet, J. Bishop, L. Roach, F. Seelos, D. Humm, and the CRISM Science Team (2008), Hydrated silicate minerals on Mars observed by the CRISM instrument on MRO, *Nature*, 454, 305-309.
- Grant, J. A., R. P. Irwin, III, J. P. Grotzinger, **R. E. Milliken**, L. L. Tornabene, A. S. McEwen, C. M. Weitz, S. W. Squyres, T. D. Glotch, and B. J. Thomson (2008), HiRISE imaging of impact megabreccia and sub-meter aqueous strata in Holden Crater, Mars, *Geology*, 36(3), 195-198.
- Milliken, R. E.**, J. F. Mustard, F. Poulet, D. Jouglet, J.-P. Bibring, B. Gondet, Y. Langevin, and the OMEGA team (2007), Hydration state of the Martian surface as seen by Mars Express OMEGA II: H₂O content of the surface, *J. Geophysical Research*, 112(E8), doi: 10.1029/2006JE002853.
- Jouglet, D., F. Poulet, **R. E. Milliken**, J. F. Mustard, J.-P. Bibring, Y. Langevin, B. Gondet, and the OMEGA team (2007), Hydration state of the Martian surface as seen by Mars Express OMEGA I: Analysis of the 3 μ m hydration feature, *J. Geophysical Research*, 112(E8), doi: 10.1029/2006JE002846.
- Pelkey, S. M., J. F. Mustard, S. Murchie, R. T. Clancy, M. Wolff, M. Smith, **R. E. Milliken**, J.-P. Bibring, A. Gendrin, F. Poulet, Y. Langevin, B. Gondet (2007), CRISM multispectral summary products: Parameterizing mineral diversity on Mars from reflectance spectra, *J. Geophysical Research*, 112(E8), doi: 10.1029/2006JE002831.
- Milliken, R. E.** and J. F. Mustard (2007), Estimating the water content of hydrated minerals using reflectance spectroscopy I: Effects of darkening agents and low-albedo materials, *Icarus*, 189, 550-573.
- Milliken, R. E.** and J. F. Mustard (2007), Estimating the water content of hydrated minerals using reflectance spectroscopy II: Effects of particle size, *Icarus*, 189, 574-588.
- Milliken, R. E.**, and J. F. Mustard (2005), Quantifying absolute water content of minerals using near-infrared reflectance spectroscopy, *J. Geophysical Research*, 110(E12), doi: 10.1029/2005JE002534.
- Head, J. W., J. F. Mustard, M. A. Kreslavsky, **R. E. Milliken**, and D. R. Marchant (2003), Recent ice ages on Mars, *Nature*, 426, 797-802.
- Milliken, R. E.**, J. F. Mustard, and D. L. Goldsby (2003), Viscous flow features on the surface of Mars: Observations from high-resolution Mars Orbiter Camera (MOC) images, *J. Geophysical Research*, 108(E6), doi: 10.1029/2002JE002005.

Recent Invited Talks

- Milliken, R. E. (2008), **Invited**, Which clays are really present on Mars and how did they form?, *Workshop on Martian Phyllosilicates: Recorders of Aqueous Processes?*, LPI, Paris, France.
- Milliken, R. E., J. Grotzinger, J. Grant, R. Arvidson, and S. Murchie (2008), **Invited**, Understanding sedimentary sources and sinks on Mars from orbit, *GSA Annual Meeting*, Houston, TX.
- Milliken, R. E., J. Mustard, B. Ehlmann, J. Bishop, S. Murchie (2008), **Invited**, Interpreting and constraining the composition and depositional environments of phyllosilicates on Mars, *Ground Truth from Mars: Science Payoff from a Sample Return Mission*, #4036, LPI, Albuquerque, NM.
- Milliken, R. E. (2007), **Invited**, Water on Mars and the hydration state of the Martian surface, *ASTRO/EPS 250 Seminar*, Univ. Cal. Berkeley.

TEACHING EXPERIENCE

2008 *JPL/Caltech Summer Undergraduate Research Fellowship Mentor*

Mentored a student during a summer internship at JPL/Caltech, including oversight of the student's research project, training the student in the necessary GIS and computer skills, and assisting the student with writing a report of the scientific results.

2007 *Guest Lecturer*

California Institute of Technology

Geology GE112a: Sedimentology and Stratigraphy

Presented a lecture on sedimentary environments, depositional processes, and structural controls of sedimentary basins on Mars. The lecture focused on discussing the mineralogy, petrology, sediment transport, and structure of sedimentary environments on Mars to those found on Earth.

2007 *Invited Lecturer*

University of California, Berkeley

ASTRO/EPS 250 Seminar: The Role of Water in Planetary Science

Presented a lecture on applying laboratory-based models to reflectance spectra acquired by Mars Express OMEGA to derive the water content of the Martian surface. Variations in water content through space and time and its effects on the alteration of the crust were discussed.

2005 - 2006 *Supplemental Science Instructor, 4th grade* Providence Public Schools

Taught lessons on the Moon, the planets, and simple machines to several 4th grade classes at Fox Point Elementary School in Providence, RI.

2005 *Harriet W. Sheridan Center Teaching Certification I* Brown University

A series of lectures and seminars geared towards understanding different learning styles and preparing graduate students for their roles as teachers, including an individual teaching assessment.

2003 - 2004 *Teaching Assistant*

Brown University

Geology GE133: Global Environmental Remote Sensing

Taught and organized lab sections, revised labs from UNIX to PCs, advised students on class projects, lectured when professor was absent, held regular office hours.